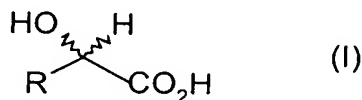


We claim:

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1. A method for the microbiological isomerization of alpha-hydroxycarboxylic acids of the formula I

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where

10 R is straight-chain or branched C₂-C₈ alkyl or C₂-C₈ alkenyl or -(CH₂)_n-Cyc, where n is an integer of 0 to 4, and Cyc is an unsubstituted or mono- or polysubstituted, mono- or binuclear carbo- or heterocyclic ring,

15 where a substrate comprising essentially a first stereoisomeric form of an alpha-hydroxycarboxylic acid of the formula (I) is isomerized with the aid of an enzyme with alpha-hydroxycarboxylic acid racemase activity and, if appropriate, the resulting isomer mixture or a resulting second stereoisomer is isolated, or a resulting second stereoisomer is removed from the reaction equilibrium,

20 wherein the enzyme is a lactate racemase with an expanded substrate spectrum, which isomerizes at least one further alpha-hydroxycarboxylic acid of the formula I.

2. A method as claimed in claim 1, wherein the enzymatic isomerization is effected by converting the substrate with purified enzyme, an enzyme-containing cell
25 extract or in the presence of intact cells which express at least one enzyme with alpha-hydroxycarboxylic acid racemase activity.
3. A method as claimed in any of the preceding claims, wherein the enzyme with alpha-hydroxycarboxylic acid racemase activity can be isolated from
30 microorganisms of the genus *Lactobacillus* or *Lactococcus*.
4. A method as claimed in any of claims 1 to 3, wherein the conversion is carried out in the presence of intact cells of microorganisms of the genus *Lactobacillus*

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or *Lactococcus* or intact cells of a recombinant microorganism which express alpha-hydroxycarboxylic acid racemase activity.

5. A method as claimed in claim 4, wherein the microorganism is selected from among *L. paracasei*, *L. delbrueckii*, *L. sakei* and *L. oris*.
5
6. A method as claimed in claim 5, wherein the microorganism is selected from among the strains *L. paracasei* DSM 20207 (DSM 15755) and DSM 2649 (DSM 15751), *L. delbrueckii* DSM20074 (DSM 15754), *L. sakei* DSM 20017 (DSM 15753) and *L. oris* DSM 4864 (DSM 15752).
10
7. A method as claimed in any of the preceding claims, wherein the enzyme isomerizes at least one compound selected from among phenyl lactate, 4-fluorophenyl lactate, 2-hydroxy-4-phenylbutyric acid, 2-hydroxy-4-methylpentanecarboxylic acid, 2-hydroxy-3-methylbutyric acid.
15
8. A screening method for microorganisms which express an enzyme with alpha-hydroxycarboxylic acid racemase activity, wherein a lactate-producing or lactate-metabolizing microorganism, in which the racemase activity is expected, is grown in the presence of a substrate comprising essentially a stereoisomeric form of an alpha-hydroxycarboxylic acid of the above formula I, and the reaction medium is examined for racemization of the substrate.
20
9. A screening method as claimed in claim 8, wherein the microorganisms as defined in claim 4 or 5 are screened.
25
10. A screening method as claimed in claim 8 or 9, wherein microorganisms which racemize the essentially stereoisomeric substrate to 1 to 100% are screened for.
11. An alpha-hydroxycarboxylic acid racemase obtainable by growing a microorganism which has tested positively for racemase activity in a screening method as claimed in any of claims 8 to 10 and isolating the alpha-hydroxycarboxylic acid racemase from the culture.
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12. An alpha-hydroxycarboxylic acid racemase as claimed in claim 11, which racemizes at least one alpha-hydroxycarboxylic acid of the above formula I to 1 to 100%, preferably 20 to 100%, in particular 50 to 100%.
- 5 13. A nucleic acid sequence encoding at least one alpha-hydroxycarboxylic acid racemase as claimed in claim 11 or 12.
14. An expression vector comprising a coding nucleic acid sequence as claimed in claim 13 in operable linkage with at least one regulatory nucleic acid sequence.
- 10 15. A recombinant prokaryotic or eukaryotic microorganism comprising at least one nucleic acid sequence as claimed in claim 13 or at least one expression vector as claimed in claim 14.
- 15 16. A method for producing a protein with alpha-hydroxycarboxylic acid racemase activity, wherein a recombinant microorganism as claimed in claim 16 is grown and the protein is isolated from the culture.
- 20 17. A method for isolating a protein with alpha-hydroxycarboxylic acid racemase activity, wherein a microorganism which has tested positively for racemase activity is disrupted, cell wall fragments are removed and the protein with the desired enzyme activity is isolated.
- 25 18. A method as claimed in any of claims 1 to 7, wherein the desired stereoisomer is essentially removed from the isomer mixture formed and the remainder is subjected to a further isomerization step.
- 30 19. A method as claimed in any of claims 1 to 7, wherein the isomer mixture formed is subjected to a chemical or enzymatic stereoselective subsequent reaction and the reaction mixture obtained is subjected to a further isomerization step.
- 35 20. A method as claimed in any of claims 1 to 7, wherein the isomerization reaction is coupled with a chemical or enzymatic, enantioselective subsequent reaction, during which reaction the resulting desired stereoisomer of the alpha-hydroxycarboxylic acid is removed from the reaction equilibrium.

21. A method as claimed in claim 19 or 20, wherein the chemical or enzymatic, enantioselective subsequent reaction is selected from among an esterification and an amidation of the alpha-hydroxycarboxylic acid.